

## GROWTH PERFORMANCE OF MAJOR SPICES IN GUJARAT STATE

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### ABSTRACT

*The study examines growth performance of major spice crops in Gujarat state for different districts. The study reveals that growth performance of major spice crops was found to be significant increase in production (11.35% / annum) and yield (3.82% / annum) in Gujarat during 1994-95 to 2012-13. The area under spices increased at the highest rate (10.37% / annum) in Saurashtra region while the highest rate of increase in production (22.95 % / annum) and yield (14.33% / annum) was observed in South Gujarat region. The lowest indices of instability of area (15.42) and production showed its stability in traditionally spices grown region of North Gujarat. The district of Porbandar, Dang and Narmada registered the highest rate of growth, respectively in area, production and yield of species. The negative and significant growth of productivity of spices, in Junagadh and Porbandar districts and non significant growth in Saurashtra region shows the matter of concern for the region.*

**KEYWORDS:** Compound Growth Rate, Instability Index & Regional Disparity

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### INTRODUCTION

A years ago as one of the potential agricultural enterprises in accelerating the growth of economy was in the field of Horticulture. Horticulture plays an important role in the country's nutritional security, alleviation of poverty and helps in generating the employment which are becoming increasingly important. Horticulture performs its activity in two ways and it offers not only a wide range of options to the farmers for diversification of crops, but also provides ample scope for sustaining large number of Agro-industries, which generate huge employment opportunities. On account of significant production increases in horticultural crops across the country, a Golden Revolution is in the offing and India has emerged as a leading player in the global scenario. At present, India has emerged as the world's largest producer of coconut and tea, and India is the second largest producer and exporter of tea, coffee, cashew and spices. There is much pick up in the exports of fresh and processed fruits, vegetables, cut flowers, dried flowers. As a result of a number of thoughtful research, technological and policy initiatives and inputs, horticulture in India, today, has become a sustainable and viable venture for both small and marginal farmers.

In horticulture the international trade is stimulated by raising incomes and growing consumers' interest in a variety of fresh fruits and vegetables year-round. By this India has got several advantages in this sector. India is called to be the one of the world's biggest producers of horticultural products. The production costs are less than half of those in other parts of the world. Despite these advantages, India's share in the global market is found to be insignificant and it accounts only for 1.7 per cent of the global trade in vegetables and 0.5 per cent in fruits. India is found to be the second largest producer of fruits and vegetables contributing 10 per cent and 14 per cent,

respectively in the world fruit and vegetable production.

Horticulture crops have the advantage of providing higher productivity per unit of land compared to other crops in Gujarat as well as resulting in higher income and higher rural employment generation. India is the second largest producing country in the World, next to China. The gross cropped area of Horticulture accounts for about 13.08 per cent (192.79 mha) in the country and contributes around 30 per cent to Indian Agricultural GDP. Its share is about 37 per cent of the total exports of agricultural commodities. During 1991-92 the area under horticulture crops was 12.77 mh a and it has got increased to 23.69 million hectares during 2012-13. The total production during this period has increased by nearly 2.8 times and corresponding productivity has increased to 1.5 times. As compared to 257.1 mt of food grain production during 2012-13, the total horticulture production was 268.9 mt. During 2012-13 the annual growth rates for area and production of horticulture crops over 2011-12 were 1.9 per cent and 4.5 per cent, respectively. In comparison with other horticulture crops the percentage share of vegetables production in the total horticulture production was highest (60.3 % during 2012-13). The total horticulture production was highest in case of West Bengal (292 lakh tonnes) followed by Andhra Pradesh (289.13 lakh tonnes). During 2012-13, the highest share was seen in West Bengal and was 33.14%. In case of spices, Andhra Pradesh contributed the major share of 20.7 per cent in terms of production. It has also been seen that during 2013-14 the total value of export of horticulture produce from India to different countries was Rs. 14365 crores.

Horticulture crops have inherent advantage of providing higher productivity per unit of land compared to other crops in Gujarat as well, which results in generation of higher income and higher rural employment. The horticulture sector is labour intensive which provide more employment and because of value addition potential, it gives higher income. Fruits and vegetable cultivation can provide sustained income and work to small and marginal farmers. Horticultural crops include major four groups viz. Fruits, Vegetables, Spices and Flowers with its shares in 2012-13 to the tune of 26, 36, 37 and 1 percent of the total horticulture area, respectively in the state. The total estimated area under horticultural crops has been increased from 5.89 lakh ha during the year 1998-99 to 15.03 lakh ha during the year 2012-13. Similarly, the estimated production of horticultural crops as been increased from 59.49 lakh tonnes during 1998-99 to 204.55 lakh tones with an average productivity of 13.61 tonnes per ha during the year 2012-13. Gujarat occupies 4<sup>th</sup>, 6<sup>th</sup> and 3<sup>rd</sup> places in India in production of fruit, vegetable and spices, respectively. The horticulture area is 16.5 per cent of the total agricultural area while the value of production of horticulture crop is Rs.11000 crores with its share of 23 per cent as against Rs. 48000 crores of total agriculture production.

The area of fruits, vegetables, & flowers has been estimated to 3.98 lakh ha, 5.38 lakh ha, and 0.17 lakh ha in the state for the year 2012-13, which shows an increase of 4.21, 3.87, and 8.27 per cent over the previous year 2011-12, respectively. Whereas the area under spice crops have decreased marginally in the year 2011-12 from 5.71 lakh ha to 5.49 lakh ha in the year 2012-13. The production of fruits, vegetables, spices & flowers has been estimated to 85.31 lakh tonnes, 105.21 lakh tonnes, 12.54 lakh tones & 1.49 lakh tonnes in the state for the year 2012-13, showing an increase of 9.89, 4.69, 7.27 & 9.56 per cent over the previous year 2011-12, respectively. The yield was worked out to be 21.41, 19.57, 2.28 & 8.64 tonnes per hectare, for fruits, vegetables, spices & flowers in the state for the year 2012-13, respectively.

Gujarat has a wide variety of soils, rainfall pattern, temperature regimes, and availability of irrigation. This diverse agro-climatic situation across the state holds promise for development of the horticulture sector in a big way. Gujarat has tropical climate, with temperature ranging from a minimum of 13° C to 27° C in January and a maximum of 45° C in May-June. However, there is a wide annual variation in rainfall, affecting the productivity of the crops.

The investment in fruit and vegetable processing units increased in the state which shows shining future of horticulture in the Gujarat State. Considering the importance of the horticulture sector in the Gujarat state, the present study was undertaken with the following specific objectives.

## OBJECTIVES

- To work out the district wise compound growth rates of area, production and productivity of major spice crops of the state.
- To estimate the district wise instability indices of area, production and productivity of major spice crops of the state.
- To study the regional disparity in growth performance of the spice crops of the state.

## METHODOLOGY

In order to achieve the objectives of study, district wise time series data on area, production and yield of major spice crops of the state were collected and compiled from the Directorate of Horticulture, Gujarat State, Gandhi nagar for the period from 1994-95 to 2012-13. The district-wise and region-wise compound growth rates (CGRs) of area, production and productivity of major horticultural crops were computed. The compound growth rates were calculated by fitting the exponential function given below:

$$Y = a b^t \quad (1)$$

Where,

Y = area/ production/ productivity

a = Constant

b = Regression Co-efficient

t = Time variable

Thus, natural log on both the sides of equation(1) was taken to convert it into linear form.

$$\text{Log } Y = \log a + t \log b \quad (2)$$

The annual Compound Growth Rates (CGRs) were finally worked out using the following formula:

$$\text{CGR (\%)} = (\text{Anti log of } \log b - 1) \times 100$$

The Co-efficient of variation (CV) often contains the trend component and thus over estimates the level of instability in time series data characterized by long-term trends. To overcome this problem, the Cuddy Della Valle index was used which corrects the CV by:

$$\text{Instability Index (I I)} = \text{CV} * \sqrt{(1 - R^2)}$$

Where, CV = Co-efficient of variation and

$R^2$  = Co-efficient of determination from a time trend regression

adjusted by the number of degrees of freedom

## RESULTS AND DISCUSSIONS

The results of district-wise and region-wise compound growth rates as well as instability indices of area, production and yield of total spices and individual spice crops namely; cumin, isabgul, coriander, chilli and garlic are presented and discussed in this paper.

### Spice Crops

The results of compound growth rates and instability indices for area, production and yield of total spices are given in Table 1. The area under spices significantly increased at the rate of 7.25 per cent per annum along with significant increase in production (11.35% / annum) and yield (3.82% / annum) in Gujarat during 1994-95 to 2012-13. The area under spices remained more stable as compared to production and yield. It may be due to the fact that the spices are more sensitive to biotic and abiotic factors. The acreage under spices increased at the highest rate (10.37%/ annum) in Saurashtra region while the highest rate of increase in production (22.95 % / annum) and yield (14.33%/ annum) was observed in South Gujarat region. The lowest indices of instability of area (15.42) and production showed its stability in traditionally spices grown region of North Gujarat. The district of Porbandar, Dang and Narmada registered the highest rate of growth, respectively in area, production and yield of species. The negative and significant growth of productivity of spices, in Junagadh and Porbandar districts and non significant growth in Saurashtra region shows the matter of concern for the region. Comparatively higher instability indices of area, production and yield in majority of district implies the acreage response of spices to price fluctuation as well as the sensitivity of productivity of species to biotic and a biotic factors.

**Table 1: Compound Growth Rates and Instability Index for Area, Production and Yield of Spices (1994-95 to 2012-13)**

| Sr. No. | District / Region | Compound Growth Rates (%p.a.) |            |        | Instability Index (I.I.) |            |       |
|---------|-------------------|-------------------------------|------------|--------|--------------------------|------------|-------|
|         |                   | Area                          | Production | Yield  | Area                     | Production | Yield |
| 1       | Ahmedabad         | 01.54#                        | 01.11#     | -0.44# | 25.85                    | 29.37      | 16.95 |
| 2       | Amreli            | 04.52#                        | 06.42#     | 01.84# | 59.36                    | 57.89      | 43.81 |
| 3       | Banaskantha       | 04.98                         | 11.65      | 06.34  | 27.34                    | 40.56      | 28.60 |
| 4       | Bharuch           | 08.44                         | 26.25      | 16.43  | 43.56                    | 88.70      | 68.25 |
| 5       | Narmada           | 13.55                         | 45.93      | 28.50  | 35.22                    | 49.93      | 47.65 |
| 6       | Bhavnagar         | 05.73*                        | 11.01      | 04.99* | 43.49                    | 59.50      | 57.56 |
| 7       | Dang              | 22.58                         | 46.66      | 19.23  | 38.42                    | 59.67      | 54.90 |
| 8       | Gandhinagar       | 10.75                         | 26.61      | 14.33  | 33.65                    | 44.96      | 54.70 |
| 9       | Jamnagar          | 09.98                         | 08.36*     | -1.47# | 41.68                    | 60.23      | 38.58 |
| 10      | Junagadh          | 13.83                         | 07.59      | -5.48  | 46.99                    | 50.63      | 78.89 |
| 11      | Porbandar         | 35.00                         | 24.84      | -7.53  | 48.62                    | 59.93      | 46.41 |
| 12      | Kutchh            | 06.86                         | 11.80      | 04.62  | 25.89                    | 27.97      | 16.88 |
| 13      | Kheda             | -5.29                         | 1.21#      | 06.87  | 31.35                    | 34.27      | 30.40 |
| 14      | Anand             | 08.47                         | 12.71      | 03.91* | 14.64                    | 22.68      | 27.79 |
| 15      | Mehsana           | 02.21#                        | 06.99      | 04.69  | 31.73                    | 30.66      | 15.98 |
| 16      | Patan             | 09.18*                        | 13.90      | 04.29* | 33.10                    | 29.85      | 22.67 |
| 17      | Panchmahal        | 06.49                         | 09.70      | 03.02* | 47.50                    | 77.33      | 31.37 |
| 18      | Dahod             | 15.58                         | 16.07      | 00.43# | 33.67                    | 31.71      | 19.84 |
| 19      | Rajkot            | 07.01*                        | 12.42      | 05.06  | 48.63                    | 56.93      | 37.15 |
| 20      | Sabarkantha       | 00.64#                        | 06.67      | 05.99  | 28.67                    | 35.74      | 47.97 |
| 21      | Surat             | 00.84#                        | 12.86      | 11.93  | 80.14                    | 37.03      | 58.10 |
| 22      | Surendranagar     | 10.85                         | 15.79      | 04.44  | 30.45                    | 56.83      | 29.99 |
| 23      | Vadodara          | 12.06                         | 24.24      | 10.88  | 36.07                    | 54.84      | 38.82 |
| 24      | Valsad            | -5.32                         | 05.21#     | 11.12  | 34.79                    | 73.48      | 50.50 |
| 25      | Navsari           | 05.57#                        | 29.28      | 22.44  | 102.46                   | 61.69      | 43.99 |

| Table 1: Contd., |                |              |              |              |              |              |              |
|------------------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 26               | Tapi           | 15.40        | 30.91        | 13.44*       | 12.23        | 33.20        | 20.46        |
| 27               | <b>Gujarat</b> | <b>07.25</b> | <b>11.35</b> | <b>03.82</b> | <b>13.15</b> | <b>30.62</b> | <b>24.61</b> |
| 28               | Saurashtra     | 10.37        | 10.60        | 00.21#       | 31.65        | 44.42        | 24.45        |
| 29               | North Gujarat  | 05.69        | 11.23        | 05.24        | 15.42        | 19.83        | 22.48        |
| 30               | South Gujarat  | 07.53        | 22.95        | 14.33        | 44.83        | 51.54        | 33.37        |
| 31               | Middle Gujarat | 03.25        | 10.96        | 07.46        | 17.29        | 28.27        | 22.16        |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

The area (8.56% / annum), production (12.54%/annum) and yield (3.69% / annum) of cumin significantly increased in Gujarat during 1994-95 to 2012-13 (table 2). The instability index of area under cumin to the tune of 13.78 was lower than that of production (25.70) as it reflects the fluctuation in area as well as yield. Among the four region of the state, South Gujarat registered the highest rate of growth in area (30.94%/ annum) and production (32.44% / annum) because of increase in cultivation of cumin in recent years. The highest rate of increase in productivity (4.54%/ annum) was observed in the traditionally cumin cultivated region of North Gujarat. The Saurashtra region remained at second position in the rate of increase in area, production and yield of cumin among the four regions. The highest rate of increase in area, production and yield of cumin in Porbandar district is also reflected by the highest rate of increase in area under total spices. The area, production and productivity of cumin found more stable in Narmada district while it was highly instable in Amreli district. Higher instability of cumin cultivation in Saurashtra region may be due to its dependence on shallow aquifer ground water irrigation which in turn depends on previous season rainfall.

**Table 2: Compound Growth Rates and Instability Index for Area, Production and Yield of Cumin (1994-95 to 2012-13)**

| Sr. No. | District /Region | Compound Growth Rates (%p.a.) |              |              | Instability Index (I.I.) |              |              |
|---------|------------------|-------------------------------|--------------|--------------|--------------------------|--------------|--------------|
|         |                  | Area                          | Production   | Yield        | Area                     | Production   | Yield        |
| 1       | Ahmedabad        | 03.34#                        | 02.05#       | -1.24#       | 32.53                    | 39.40        | 18.58        |
| 2       | Amreli           | 08.99#                        | 09.85*       | 00.80#       | 77.21                    | 78.23        | 92.37        |
| 3       | Banaskantha      | 03.88*                        | 10.41        | 06.31        | 36.62                    | 50.78        | 29.06        |
| 4       | Narmada          | 30.94                         | 32.44        | 01.15#       | 22.07                    | 20.59        | 02.54        |
| 5       | Bhavnagar        | 10.80                         | 17.49        | 04.98        | 56.31                    | 71.28        | 29.91        |
| 6       | Gandhinagar      | 03.78#                        | 07.41#       | 03.45#       | 39.80                    | 51.78        | 40.18        |
| 7       | Jamnagar         | 21.63                         | 25.24        | 02.95*       | 47.10                    | 57.23        | 26.12        |
| 8       | Junagadh         | 20.90                         | 25.15        | 03.50        | 44.65                    | 50.84        | 22.87        |
| 9       | Porbandar        | 47.16                         | 59.12        | 08.13        | 40.23                    | 41.95        | 20.32        |
| 10      | Kutchh           | 12.69                         | 13.22        | 00.47#       | 43.02                    | 41.63        | 16.56        |
| 11      | Kheda            | -7.54                         | -6.28*       | 01.39#       | 48.61                    | 77.98        | 108.01       |
| 12      | Anand            | -6.96#                        | -3.87#       | 03.32        | 59.85                    | 65.58        | 06.11        |
| 13      | Mehsana          | -0.93#                        | 02.46#       | 03.38        | 42.17                    | 38.49        | 22.20        |
| 14      | Patan            | 04.72#                        | 10.82        | 05.69        | 34.82                    | 33.36        | 14.25        |
| 15      | Panchmahal       | -6.64                         | -1.69#       | 04.54        | 50.97                    | 52.06        | 23.91        |
| 16      | Rajkot           | 07.90*                        | 10.78        | 02.68        | 51.51                    | 50.28        | 15.60        |
| 17      | Sabarkantha      | 04.20*                        | 02.41#       | -1.72#       | 39.81                    | 38.01        | 26.87        |
| 18      | Surendranagar    | 12.47                         | 16.84        | 03.90        | 30.46                    | 55.55        | 29.01        |
| 19      | Vadodara         | 23.89                         | 27.72        | 02.89#       | 35.59                    | 32.74        | 31.79        |
| 20      | <b>Gujarat</b>   | <b>08.56</b>                  | <b>12.54</b> | <b>03.69</b> | <b>13.78</b>             | <b>25.70</b> | <b>20.24</b> |
| 21      | Saurashtra       | 13.40                         | 17.61        | 03.72        | 27.20                    | 37.43        | 21.26        |
| 22      | North Gujarat    | 04.83                         | 09.59        | 04.54        | 23.29                    | 27.16        | 22.00        |
| 23      | South Gujarat    | 30.94                         | 32.44        | 01.15        | 22.07                    | 20.59        | 02.54        |
| 24      | Middle Gujarat   | 03.18*                        | 02.20#       | -0.95#       | 29.39                    | 37.27        | 18.10        |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

The negative and significant growth rate of area of isabgul in Gujarat including all the regions as well as all the districts except Banaskantha revealed significant decline in cultivation of isabgul during 1994-95 to 2012-13 (table 3). It was cultivated in 42025 ha with production of 26060 tonnes in 1994-95. The area under isabgul considerably declined to 15752 ha with production of 23929 tonnes in 2012-13 in the state. The growth of productivity of isabgul found positive and significant in Gujarat due to positive increase in yield in North Gujarat region. The higher instability indices were also observed in majority of districts.

**Table 3: Compound Growth Rates and Instability Index for Area, Production and Yield of Isabgul (1994-95 to 2012-13)**

| Sr. No. | District / Region | Compound Growth Rates (%p.a.) |                |              | Instability Index (I.I.) |              |              |
|---------|-------------------|-------------------------------|----------------|--------------|--------------------------|--------------|--------------|
|         |                   | Area                          | Production     | Yield        | Area                     | Production   | Yield        |
| 1       | Ahmedabad         | -4.27#                        | -5.10#         | 00.02#       | 79.73                    | 81.01        | 52.08        |
| 2       | Amreli            | -23.54                        | -25.49         | -2.50        | 65.33                    | 68.46        | 12.79        |
| 3       | Banaskantha       | 00.17#                        | 08.48          | 08.27*       | 42.21                    | 41.80        | 98.22        |
| 4       | Jamnagar          | -32.03                        | -33.33         | -2.04#       | 71.96                    | 78.28        | 33.66        |
| 5       | Junagadh          | -8.27#                        | -7.27#         | 01.15#       | 75.87                    | 70.42        | 83.65        |
| 6       | Kutchh            | -1.78#                        | -2.63#         | -0.86#       | 34.03                    | 33.77        | 14.38        |
| 7       | Kheda             | -6.81*                        | -4.08#         | 03.49        | 50.65                    | 54.38        | 32.37        |
| 8       | Mehsana           | -3.51#                        | -2.34#         | 01.23#       | 57.06                    | 57.61        | 15.04        |
| 9       | Patan             | -10.93                        | -5.40*         | 06.32        | 39.43                    | 39.72        | 21.48        |
| 10      | Rajkot            | -30.12                        | -33.96         | -5.56#       | 37.10                    | 39.84        | 23.31        |
| 11      | Sabarkantha       | -3.63*                        | -2.33#         | 01.35#       | 60.65                    | 46.46        | 22.85        |
| 12      | Surendranagar     | -5.20#                        | -2.97#         | 02.36#       | 65.78                    | 163.39       | 131.79       |
| 13      | <b>Gujarat</b>    | <b>-2.63*</b>                 | <b>01.77 #</b> | <b>04.54</b> | <b>26.00</b>             | <b>26.35</b> | <b>31.24</b> |
| 14      | Saurashtra        | -10.89                        | -9.47*         | 01.59#       | 60.52                    | 82.67        | 111.63       |
| 15      | North Gujarat     | -0.84#                        | 06.61          | 07.51*       | 39.96                    | 37.53        | 56.31        |
| 16      | Middle Gujarat    | -5.36*                        | -4.53*         | 00.87#       | 47.47                    | 40.39        | 59.76        |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

The rate of increase in area (16.40% / annum), production (22.11% / annum) and yield (4.91 % / annum) of coriander was significant in Gujarat during 1994-95 to 2012-13 (table 4). The growth of area and production was non significant in North and Middle Gujarat, while the growth of area was the highest in Saurashtra (19.57%/ annum) followed by South Gujarat. The instability of area, production and yield was comparatively higher in North and Middle Gujarat than Saurashtra and South Gujarat regions. Among the different districts of Gujarat, the Dahod registered highest growth in area, production and yield of coriander. The stability of area, production and yield was the highest in Tapi district.

**Table 4: Compound Growth Rates and Instability Index for Area, Production and Yield of Coriander (1994-95 to 2012-13)**

| Sr. No. | District / Region | Compound Growth Rates (%p.a.) |            |        | Instability Index (I.I.) |            |        |
|---------|-------------------|-------------------------------|------------|--------|--------------------------|------------|--------|
|         |                   | Area                          | Production | Yield  | Area                     | Production | Yield  |
| 1       | Ahmedabad         | -2.80#                        | -3.34#     | -0.54# | 58.72                    | 64.57      | 24.70  |
| 2       | Amreli            | -0.42#                        | -0.86#     | -0.45# | 53.19                    | 57.94      | 32.75  |
| 3       | Banaskantha       | 07.97*                        | 06.15#     | -1.71# | 51.40                    | 67.24      | 25.53  |
| 4       | Bharuch           | 42.04                         | 41.28      | -0.53# | 74.77                    | 55.54      | 102.61 |
| 5       | Narmada           | -8.02#                        | -5.92#     | 01.96# | 88.87                    | 81.11      | 14.56  |
| 6       | Bhavnagar         | -1.48#                        | 03.78#     | 05.34  | 81.53                    | 73.53      | 30.54  |
| 7       | Gandhinagar       | -2.09#                        | -11.08#    | -9.95  | 184.49                   | 185.78     | 34.90  |
| 8       | Jamnagar          | 25.08                         | 28.96      | 03.11# | 54.47                    | 59.87      | 31.69  |
| 9       | Junagadh          | 37.89                         | 43.29      | 03.92* | 65.40                    | 66.85      | 43.62  |
| 10      | Porbandar         | 23.56                         | 28.87      | 04.31  | 79.93                    | 84.99      | 14.88  |

| Table 4: Contd., |                |              |              |              |              |              |              |
|------------------|----------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 11               | Kutchh         | 26.32        | 35.12        | 06.99        | 51.97        | 53.41        | 17.52        |
| 12               | Kheda          | -13.89       | -12.97       | 01.07#       | 72.30        | 73.99        | 14.83        |
| 13               | Anand          | -3.45#       | -0.56#       | 02.99        | 45.29        | 45.58        | 10.40        |
| 14               | Mehsana        | 09.94*       | 09.56*       | -0.35#       | 65.36        | 61.53        | 67.15        |
| 15               | Panchmahal     | -3.38#       | -2.25#       | 01.17#       | 204.44       | 205.10       | 18.48        |
| 16               | Dahod          | 69.12        | 118.67*      | 29.30*       | 128.97       | 162.25       | 87.15        |
| 17               | Rajkot         | 03.44#       | 06.90*       | 03.34        | 68.10        | 66.71        | 16.97        |
| 18               | Sabarkantha    | 00.12#       | 03.18*       | 03.06        | 29.69        | 24.26        | 6.57         |
| 19               | Surat          | -16.16#      | -35.92#      | -25.74*      | 29.53        | 41.26        | 35.14        |
| 20               | Surendranagar  | 13.33*       | 23.03        | 07.31        | 51.21        | 44.04        | 23.91        |
| 21               | Vadodara       | -0.99#       | -0.49#       | 00.52#       | 54.57        | 45.40        | 31.91        |
| 22               | Valsad         | 01.83#       | 05.74#       | 03.84*       | 46.75        | 46.17        | 20.98        |
| 23               | Navsari        | 64.10        | 69.38        | 03.21*       | 23.42        | 23.68        | 4.81         |
| 24               | Tapi           | 10.89#       | 11.19*       | 00.27#       | 18.09        | 18.21        | 0.58         |
| 25               | <b>Gujarat</b> | <b>16.40</b> | <b>22.11</b> | <b>04.91</b> | <b>38.88</b> | <b>40.93</b> | <b>29.83</b> |
| 26               | Saurashtra     | 19.57        | 23.68        | 03.44        | 52.34        | 53.39        | 29.87        |
| 27               | North Gujarat  | 06.63#       | 06.93#       | 00.28#       | 120.29       | 118.11       | 09.47        |
| 28               | South Gujarat  | 14.97        | 29.08        | 12.27        | 34.59        | 57.71        | 52.86        |
| 29               | Middle Gujarat | -2.04#       | 01.66#       | 03.78#       | 79.98        | 279.86       | 94.22        |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

The result of compound growth rates of chilli revealed that the area, production and yield of the crop increased at the rate of 5.66, 7.05 and 10, 77 per cent per annum, respectively during 1994-95 to 2012-13 (table 5). The region wise result showed that the area and production of chill increased at the highest rate in South Gujarat, while yield increased at highest rate in North Gujarat. The non significant growth of area implies that the area of chilli was stagnated in the Saurashtra region. The instability indices of area ranges from 19.81 (North Gujarat) to 30.92 (South Gujarat), production ranges from 66.39 (North Gujarat) to 80.77 (Saurashtra) and yield ranges from 60.94 (Middle Gujarat) to 75.47 (South Gujarat). The Dang district registered the highest rate of increase in area, while Narmada district registered the highest rate of increase in production and yield of chilli. Negative and significant growth of area showed decline in chilli cultivation in Ahmedabad, Jamnagar, Mehsana and Valsad district. The lowest instability indices of area, production and yield of chilli, respectively in Porbandar (11.70), Dahod (27.02 and 33.32) showed more stability.

**Table 5: Compound Growth Rates and Instability Index for Area, Production and Yield of Chili (1994-95 to 2012-13)**

| Sr. No. | District / Region | Compound Growth Rates (%p.a.) |            |        | Instability Index (I.I.) |            |        |
|---------|-------------------|-------------------------------|------------|--------|--------------------------|------------|--------|
|         |                   | Area                          | Production | Yield  | Area                     | Production | Yield  |
| 1       | Ahmedabad         | -10.33*                       | -2.17#     | 09.10  | 79.64                    | 63.89      | 55.41  |
| 2       | Amreli            | -1.81#                        | 11.36*     | 13.42  | 58.22                    | 115.78     | 91.63  |
| 3       | Banaskantha       | 09.09                         | 16.38      | 06.68  | 45.14                    | 72.89      | 51.47  |
| 4       | Bharuch           | 05.53*                        | 23.55      | 17.06  | 40.55                    | 87.34      | 73.87  |
| 5       | Narmada           | 16.36                         | 52.33      | 31.21  | 39.89                    | 58.78      | 51.53  |
| 6       | Bhavnagar         | 05.09*                        | 21.65      | 15.74  | 45.43                    | 100.71     | 94.01  |
| 7       | Dang              | 24.07                         | 47.85      | 07.51# | 38.73                    | 80.08      | 219.24 |
| 8       | Gandhinagar       | 05.03                         | 20.33      | 14.56  | 24.64                    | 94.55      | 95.14  |
| 9       | Jamnagar          | -4.60*                        | 04.41#     | 09.44  | 53.31                    | 72.54      | 72.19  |
| 10      | Junagadh          | 17.57                         | 23.91      | 05.39# | 70.81                    | 74.45      | 98.08  |
| 11      | Porbandar         | 07.68                         | 11.42#     | 02.77# | 11.70                    | 68.16      | 96.49  |
| 12      | Kutchh            | 12.09                         | 22.36      | 09.20* | 58.78                    | 128.67     | 106.81 |
| 13      | Kheda             | 06.52*                        | 15.86      | 08.71  | 45.06                    | 76.02      | 49.15  |
| 14      | Anand             | 23.61                         | 30.04      | 05.21# | 30.30                    | 47.25      | 53.56  |

| Table 5: Contd., |                |        |         |         |       |        |        |
|------------------|----------------|--------|---------|---------|-------|--------|--------|
| 15               | Mehsana        | -4.78* | 03.68#  | 08.89   | 45.89 | 59.10  | 55.11  |
| 16               | Patan          | -8.33# | 00.36#  | 09.61   | 78.93 | 60.74  | 43.48  |
| 17               | Panchmahal     | 06.84* | 13.90   | 06.60#  | 86.98 | 109.71 | 66.94  |
| 18               | Dahod          | 16.92  | 29.11   | 09.59   | 35.24 | 27.02  | 33.32  |
| 19               | Rajkot         | 07.25# | 19.37   | 11.30   | 46.31 | 118.80 | 97.62  |
| 20               | Sabarkantha    | 13.50  | 30.45   | 14.94   | 51.67 | 80.80  | 83.27  |
| 21               | Surat          | -2.32# | 05.57#  | 08.08#  | 45.80 | 78.77  | 105.20 |
| 22               | Surendranagar  | 01.87# | 13.22*  | 11.14   | 46.39 | 110.84 | 87.05  |
| 23               | Vadodara       | 11.39  | 24.45   | 11.74   | 39.33 | 86.53  | 81.78  |
| 24               | Valsad         | -11.31 | -0.33#  | 12.38   | 58.04 | 96.91  | 87.50  |
| 25               | Tapi           | 09.86  | -13.56# | -21.31# | 7.80  | 54.79  | 41.40  |
| 26               | Gujarat        | 05.66  | 17.05   | 10.77   | 24.30 | 75.05  | 67.57  |
| 27               | Saurashtra     | 02.28# | 12.83   | 10.31   | 30.16 | 80.77  | 71.97  |
| 28               | North Gujarat  | 03.34  | 15.59   | 11.85   | 19.81 | 66.39  | 62.00  |
| 29               | South Gujarat  | 06.01  | 20.97   | 14.11   | 30.92 | 78.36  | 75.47  |
| 30               | Middle Gujarat | 11.64  | 21.24   | 08.60   | 25.51 | 62.49  | 60.94  |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

The cultivation of garlic in the state increased at the rate of 6.24 per cent per annum while its production increased at the rate of 7.65 per cent per annum during 1994-95 to 2012-13 (table 6). The major garlic production Saurashtra region of the state also registered positive and significant growth in area and production followed the growth of the same in Middle and South Gujarat region. The non significant growth of productivity of garlic in the state as well as in all four regions including major producing area of Saurashtra region is a matter of concern for the scientist to increase the productivity with the help of breakthrough technology. Lower instability indices of yield as compared to area and production in the state including all four regions implies more fluctuation in the area. The districts of Bhavnagar, Ahmedabad, Kheda and Sabarkantha registered negative and significant growth of area and production of garlic. The pattern of instability index of districts follows the pattern observed in the state and regions of the state.

**Table 6: Compound Growth Rates and Instability Index for Area, Production and Yield of Garlic (1994-95 to 2012-13)**

| Sr. No. | District / Region | Compound Growth Rates (%p.a.) |            |        | Instability Index (I.I.) |            |        |
|---------|-------------------|-------------------------------|------------|--------|--------------------------|------------|--------|
|         |                   | Area                          | Production | Yield  | Area                     | Production | Yield  |
| 1       | Ahmedabad         | -11.10*                       | -13.47     | -4.94# | 97.45                    | 48.58      | 53.92  |
| 2       | Amreli            | 07.61                         | 08.51      | 00.83# | 63.50                    | 65.31      | 19.05  |
| 3       | Banaskantha       | -4.11#                        | -2.19#     | 02.01# | 56.74                    | 42.35      | 26.60  |
| 4       | Bharuch           | 24.73#                        | 14.21      | -8.47# | 08.59                    | 25.66      | 36.69  |
| 5       | Narmada           | 33.15#                        | 35.13      | -3.71# | 24.23                    | 34.51      | 20.16  |
| 6       | Bhavnagar         | -12.31                        | -16.59     | -4.85* | 44.20                    | 66.46      | 34.98  |
| 7       | Dang              | 14.85                         | 20.48      | 04.90  | 09.32                    | 13.08      | 05.85  |
| 8       | Jamnagar          | 04.46                         | 05.86      | 01.34# | 64.27                    | 66.45      | 35.11  |
| 9       | Junagadh          | 05.54                         | 03.42      | -2.01# | 58.10                    | 54.66      | 167.38 |
| 10      | Porbandar         | -4.61#                        | -1.01#     | 03.79  | 77.95                    | 81.69      | 17.95  |
| 11      | Kutchh            | -4.24#                        | -0.58#     | 03.82# | 41.57                    | 44.91      | 17.84  |
| 12      | Kheda             | -11.63                        | -12.75     | -1.32# | 41.28                    | 43.79      | 18.22  |
| 13      | Anand             | 07.17*                        | 01.92#     | -4.94# | 50.66                    | 91.32      | 38.09  |
| 14      | Mehsana           | 01.39#                        | 03.21#     | 01.45# | 58.16                    | 72.42      | 17.92  |
| 15      | Panchmahal        | 06.06#                        | 05.93#     | -0.13# | 48.65                    | 53.54      | 23.15  |
| 16      | Dahod             | 18.12                         | 25.12      | 05.85  | 45.09                    | 45.74      | 16.81  |
| 17      | Rajkot            | 10.67*                        | 16.00      | 04.82* | 58.45                    | 60.57      | 27.56  |
| 18      | Sabarkantha       | -2.84                         | 15.90#     | 19.26# | 77.87                    | 93.30      | 60.86  |



| Table 6: Contd., |                |               |              |                |              |              |              |
|------------------|----------------|---------------|--------------|----------------|--------------|--------------|--------------|
| 19               | Surendranagar  | 07.16#        | 12.53*       | 05.00          | 95.17        | 88.64        | 24.13        |
| <b>20</b>        | <b>Gujarat</b> | <b>06.24*</b> | <b>07.65</b> | <b>01.32 #</b> | <b>44.28</b> | <b>46.13</b> | <b>22.90</b> |
| 21               | Saurashtra     | 05.59*        | 07.09*       | 01.43#         | 47.32        | 48.97        | 23.04        |
| 22               | North Gujarat  | -4.01         | -1.52#       | 02.60 #        | 35.39        | 51.76        | 19.76        |
| 23               | South Gujarat  | 10.13         | 11.00        | 00.79#         | 47.97        | 53.50        | 13.51        |
| 24               | Middle Gujarat | 11.76         | 13.31        | 01.39#         | 34.07        | 39.35        | 16.50        |

(Note: \* indicates significant at 5% level and # indicates non significant. All remaining CGRs are significant at 1% level.)

## CONCLUSIONS

The yield of spices increased comparatively at lower rate of 3.82 per cent per annum, respectively, in Gujarat during 1994-95 to 2012-13. The region of Saurashtra remained at the top among four regions of the state in the rate of increase in area and production but the same was lowest in case of yield of spices. The rate of increase in yield was the highest in South Gujarat in case of spices. The area of spices remained more stable as compared to production and yield. The stagnation of productivity of crops like garlic in Gujarat needs appropriate technological options.

